Hall Ticket No | | | | | | | | | | | Question Paper Code: BST001

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)

M.Tech I Semester End Examinations (Supplementary) - July, 2017
Regulation: IARE–R16
THEORY OF ELASTICITY AND PLASTICITY
(Structural Engineering)

Time: 3 Hours   **Max Marks: 70**

Answer ONE Question from each Unit
All Questions Carry Equal Marks
All parts of the question must be answered in one place only

UNIT – I

1. (a) Derive a compatibility equation for plane strain problem considering deformation in x-y plane only.   **[8M]**

   (b) Explain Airy's stress function and its use in elastic analysis of materials.   **[6M]**

2. (a) Derive an expression to give the relation between three elastic constants ?   **[7M]**

   (b) Briefly explain the Principal stresses and Principal plane for 2D element?   **[7M]**

UNIT – II

3. (a) Derive an expression by elastic theory to find the deflection of cantilever beam of uniform rigidity(EI) and length, L if beam is applied point load =P at free end   **[8M]**

   (b) What problem of plane stress is solved by the stress function : φ given below, where $\varphi = 3F/4C \left[xy - xy^3/3C^2 \right] + P/2 \left[y^2 \right]$ applied to a beam, width = unity and depth = 2C and P = load applied. Assume body forces are absent.   **[6M]**

4. (a) Derive an expression to find the strain components in polar coordinates for 2D problems.   **[8M]**

   (b) Derive an expression for pure bending of curved beams?   **[6M]**

UNIT – III

5. (a) Derive an expression to find the equilibrium conditions of component stresses in 3D elements subjected to normal and shear stresses?   **[8M]**

   (b) Explain the following principals in the theory of elasticity.   **[6M]**
      i. Uniqueness theorem of 2D elements
      ii. Stress invariants in 3D elements

6. (a) Determine the principal values and principal directions for the following stress function $\sigma_{\mathbf{y}}$ applied at a point with respect to the axes 0,X1 ,X2, X3   **[8M]**

$$\sigma_{\mathbf{y}} = \begin{pmatrix} 5 & 0 & 0 \\ 0 & -6 & -12 \\ 1 & -12 & 1 \end{pmatrix} \text{MPa}$$

(b) Explain the following concepts of elastic deformation of materials **[6M]**
    i. Homogeneous deformation in 3D elements
    ii. Principal axis of strain rotation

UNIT – IV

7. (a) Derive Torsional equation for prismatic bar of non circular section by stress function method? Also explain how it is applied to the triangular sections? **[8M]**

    (b) Briefly explain the following **[6M]**
        i. Membrane analogy
        ii. Hydro dynamical analogy

8. A wide flange section of I-beam, overall depth 200mm, thickness of web 20mm and flange 30mm, width of top and bottom flange each 150mm is fixed at one end and free at other end over a span 6m is subjected to torsion moment 3kN-m at free end. Calculate the Normal and Shear stress due to bending and maximum shear due to torsion. What is the angle of twist at free end? Assume : Young's modulus $E = 2 \times 10^5$ MPa, Poisson's ratio : $\mu = 0.25$. **[14M]**

UNIT – V

9. (a) Discuss Von Mises yield conditions for failure? **[7M]**

    (b) Write the assumptions made in plastic theory? **[7M]**

10. (a) Explain the terms used in the plasticity theory **[6M]**
        i. Plastic hinge
        ii. Tangent modulus

    (b) A thick cylinder of internal radius 400mm and external radius 500mm subjected to internal pressure. If the yield stress of the material 250MPa, determine the stresses when the whole of the cylinder has plastic front of radius 225mm **[8M]**

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